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EFFECTIVENESS OF TDE AGAINST THE JAPANESE BEETLE

By Walter E. Fleming and Warren W. Maines
Division of Fruit Insect Investigations

Preliminary tests were begun in 1946 to determine the effectiveness of TDE in protecting plants from attack by adult Japanese beetles (*Popillia japonica* Newm.) and for controlling the larvae in the soil. In these tests TDE was compared with DDT.

Control of Adult Beetles

In August 1946 comparative tests were made with TDE and DDT to control adult beetles in a 30-acre field of hybrid corn near Lebanon, Pa. The field was divided into 8-row plots of detasseled plants. Each plot was separated by 2 rows of plants that had not been detasseled, and each row was 1,200 feet long. Both insecticides were in the form of 25-percent emulsion concentrates. These were diluted with an equal volume of water and applied by airplane at the rate of approximately 1 1/3 gallons, or about 1 pound of toxicant, per acre. The airplane was flown within 5 feet of the tops of the plants; good coverage was obtained, with practically no drift from plot to plot. The density of the population in the plots at various intervals after treatment was estimated, 50 plants being selected at random in each plot and the number of beetles on the plants determined (table 1).

Table 1.--Comparative effectiveness of TDE and DDT in controlling Japanese beetles on corn when applied in emulsions at the rate of 1 pound of the toxicant per acre by airplane. Lebanon, Pa., 1946

Days after spraying	Number of beetles on 50 plants			Percent reduction	
	TDE	DDT	Check	TDE	DDT
3	26	20	310	92	94
7	15	3	188	92	98
11	16	9	132	88	93

During the first week after the treatments, both materials caused a reduction of over 90 percent in the population on the corn, as compared with that in the untreated corn. No significant increase in the number of beetles on the sprayed plants was observed during 11 days after the sprays were applied.

As the field was sprayed when about two-thirds of the corn was in silk, it was expected that shortly after the spraying the beetles would stop flying into the corn from adjacent fields. As a matter of fact, the numbers of beetles in the unsprayed plot decreased after the sprays were applied.

Additional tests were made in 1947 in a 20-acre field of hybrid corn near Lebanon. This field contained 186 rows of corn 1,200 feet long, running north and south. The field was divided into six plots extending across the rows from east to west, so that the rows in each plot were 200 feet long. Three plots were sprayed with DDT and three with TDE. Mist blowers were used to apply concentrated sprays, which were prepared by adding 2 pounds of a 50-percent wettable powder to 5 gallons of water. About half the predetermined volume was blown into each plot from a distance of 50 feet west of the first row and the remainder was blown above the first row from a distance of 5 feet. When the first application was made on July 31, the wind was from the west and southwest at an average velocity of 8. 2 miles per hour; during the second application 5 days later the wind was from the southwest at 3. 3 miles per hour. The first application was made when about one-third of the corn was in silk, and the second when two-thirds of it was in silk.

When the sprays were being applied, particles were observed drifting past the 100th row, about 333 feet from the western edge of the field. Definite information on the distribution of the sprays was obtained by placing sheets of paper toweling on the ground between rows in the plots to be sprayed with DDT. After the first application the toweling was collected and brought to the laboratory for analysis.[1] The results, which are summarized in table 2, show that the distribution was somewhat irregular, but the DDT deposits tended to decrease progressively as the distance from the sprayer increased. A measurable deposit was obtained throughout the plots as far as 80 rows from the western edge of the field.

1/ The samples were analyzed by R. D. Chisholm, of the Division of Insecticide Investigations

Table 2. --Distribution of DDT in a cornfield sprayed with a mist blower from the end of the field. Lebanon, Pa., 1947

DDT applied (pounds per plot)	Micrograms of DDT per square centimeter at indicated distance from western edge of field				
	1st row	10th row	20th row	40th row	80th row
0.52	1.2	0.6	1.1	0.5	0.3
1.04	5.4	1.2	1.3	1.0	.8
1.61	4.8	3.0	4.7	1.4	.7

The numbers of beetles in the central 100 feet of rows 1, 10, 20, 40, 60, 80, and 100 of each plot were determined before the sprays were applied and at intervals thereafter. Until August 11 the beetles were found on the ears and leaves of the corn and on the weeds in the rows; on August 11 practically all the beetles were on the silk. Prior to August 11 all beetles on the corn and on the weeds in the row were counted; on August 11 only the beetles on the silk were counted. The quantities applied and the beetle counts are summarized in table 3.

Although beetles were not scattered uniformly over the field, a progressive increase in numbers during the silking period was expected. This did occur in row 100, where none of the sprays had any significant effect on the population.

Each of the sprays had a definite contact action and reduced the beetle populations within 24 hours after treatment. The extent of the reduction was dependent upon the insecticide used and the distance the beetles were from the sprayer. In the 1st and 10th rows no beetles were found within 24 hours in any of the plots sprayed with DDT; 42 beetles were found in plot 1, sprayed with a total of 1.47 pounds of TDE in two applications; 2 in plot 2, which received a total of 2.68 pounds of TDE; and 29 in plot 3, which received 3.55 pounds of TDE. Some contact action of TDE was observed in the 40th row and of DDT in the 80th row.

The spray deposits did not prevent beetles from coming into the plots, and 4 to 6 days after the spraying some beetles were found in practically all the rows. The increase in the population was definitely less rapid in the DDT-sprayed plots than in those sprayed with TDE.

The important factor to consider in growing hybrid corn is the extent to which the developing ears are protected from attack by the beetles. On August 8, 6 days after the last spray was applied, the numbers of ears with and without beetles on them were determined in the central 100 feet of rows, 1, 10, 20, 30, 40, 60, and 80 in each plot. The average number of ears counted in this distance was 101. The extent to which the ears were infested is summarized in table 4. A total of 3.55 pounds of TDE per plot, applied in two sprays 5 days apart, was less effective than 1.05 pounds of DDT applied in the same manner. There was some protection as far as the 60th row in the plots sprayed with DDT but none in the 10th row sprayed with TDE. Although applying the sprays with a mist blower from the side of the field does not seem to be adequate, the results show that TDE was definitely inferior to DDT.

Table 3.--Effect of TDE and DDT applied with a mist blower on population of Japanese beetles in hybrid corn. Lebanon, Pa., 1947

Insecticide	Plot	Pounds of toxicant applied		Days after spraying	Number of beetles per 100 feet of row at indicated distances from western side of the field						
		1st spray	2nd spray		1st row	10th row	20th row	40th row	60th row	80th row	100th row
TDE	1	0.47		0	156	43	0	8	0	12	0
				1	0	16	0	5	0	9	4
				4	47	49	104	205	66	313	33
			1.00	1	2	24	30	178	150	283	75
				6	52	428	212	167	308	201	75
	2	1.11		0	19	70	0	190	0	82	10
				1	0	0	0	57	3	17	13
				4	8	45	39	443	25	319	61
			1.57	1	0	2	18	229	85	245	154
				6	17	225	168	279	298	214	200
	3	1.52		0	64	98	31	260	21	137	24
				1	0	22	3	129	26	59	14
				4	8	165	106	427	206	439	63
			2.03	1	0	7	23	159	320	213	141
				6	11	258	255	350	367	263	363
DDT	4	.52		0	135	49	16	106	9	33	1
				1	0	0	0	6	0	21	0
				4	6	9	9	123	36	274	64
			.53	1	0	0	0	17	25	136	192
				6	17	58	40	137	151	106	192
	5	1.04		0	77	22	14	94	26	12	22
				1	0	0	0	3	8	7	13
				4	8	21	8	98	61	167	88
			1.00	1	0	0	0	5	47	71	129
				6	1	67	39	187	210	209	210
	6	1.61		0	125	0	2	23	4	32	2
				1	0	0	0	2	0	2	2
				4	3	12	19	65	22	109	14
			1.50	1	0	0	0	0	16	37	26
				6	0	25	73	117	143	298	300

Table 4. --Comparative control of Japanese beetles on ears of hybrid corn with TDE and DDT applied with a mist blower. Lebanon, Pa., 1947

Insecticide	Total pounds of toxicant per plot	Percent of ears infested 6 days after last spray in indicated rows from western side of field						
		1st row	10th row	20th row	30th row	40th row	60th row	80th row
TDE	1.47	15	65	56	54	43	47	39
	2.68	6	47	50	54	50	50	43
	3.55	5	42	52	43	61	55	47
DDT	1.05	3	22	14	27	36	39	50
	2.04	1	24	14	7	40	43	50
	3.11	0	10	26	15	31	35	53

Preliminary tests were made also during the summer of 1947 to compare the effectiveness of TDE and DDT as protective sprays against the beetles on peaches. On July 14, in a generally infested orchard near Shiloh, N. J., five J. H. Hale peach trees were sprayed with 2 pounds of 50-percent TDE wettable powder per 100 gallons of water and five with 2 pounds of 50-percent DDT wettable powder; the remainder of the trees were sprayed with other materials or were left unsprayed. All sprays were applied with a small orchard sprayer. Shortly after the sprays had been applied, many dead or dying beetles were found beneath all the trees. During the next 10 days no beetles were found on the trees sprayed with DDT and only an occasional beetle on those sprayed with TDE.

Toxicity to Larvae in Soil

A preliminary test was made in the laboratory to determine the relative toxicity of TDE and DDT to third-instar larvae. TDE was intimately mixed with Sassafras sandy loam at rates equivalent to incorporating 1, 2, 5, 10, 25, 50, and 100 pounds of the material with the upper 3 inches of an acre of soil. DDT was applied at 5, 10, 25, and 50 pounds per acre. To facilitate the mixing of these toxicants with soil, dusts containing 1 or 10 percent of TDE and 10 percent of DDT were used. About 1/3 cubic foot of soil was placed in each of 72 trays 18 inches square and 3 3/4 inches deep. The experimental unit consisted of 6 trays of each treatment and 6 trays of untreated soil. The soil was brought to a temperature of 80° F. and maintained at this temperature during the experiment. Fifty third-instar larvae were put into each tray. At intervals of 2, 3, and 4 weeks the numbers of dead and living larvae in each tray were recorded. No attempt was made to separate the apparently normal individuals from the moribund. After each examination the living larvae were returned to the tray and the dead were discarded. The results of this test are summarized in table 5.

Table 5. --Comparative toxicity of TDE and DDT dusts to third-instar larvae of the Japanese beetle at various times after treatment

Insecticide	Pounds per acre	Percent mortality of 300 larvae after--		
		2nd week	3rd week	4th week
None (check)	---	8.4	12.9	19.1
TDE	1	5.3	10.7	18.7
	2	10.3	14.3	22.7
	5	18.7	23.7	27.7
	10	70.9	80.4	85.8
	25	99.3	100.0	100.0
	50	[illegible]	100.0	100.0
	100	100.0	100.0	100.0
DDT	5	29.8	44.6	55.2
	10	76.0	89.0	95.3
	25	96.7	99.7	99.7
	50	98.3	100.0	100.0

There was no significant difference in the results obtained with the two materials in the 25- and the 50-pound treatments, but the mortalities were so high that there was little opportunity for significant variation. The mortalities obtained with the 5- and the 10-pound treatments were compared and analyzed by the chi-square method. The mortality with DDT was significantly higher in two of the six comparisons, approaching significance in one and not significantly different from TDE in three. The results suggest that TDE is slightly less toxic to the larvae than DDT.

Control of Larvae in Turf

In the spring of 1947 TDE was applied as a dust at the rate of 25 pounds of the active ingredient per acre to the surface of four 1/4-acre plots of turf for control of the larvae. Two of these plots were at [illegible]

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At the same time four plots in the same localities were treated with DDT at the rate of 25 pounds per acre (250 pounds of a 10-percent dust). All applications were made with a 3-foot fertilizer spreader.

Surveys were made periodically to determine the effect of the treatments on the larvae. Fifteen 1-square-foot diggings were made at random in each plot, and an equal number of diggings were made in untreated turf in the vicinity of each plot. The number of larvae found in each hole was recorded, and the density of the population in the treated and in the untreated areas was estimated. The results obtained with the 1946-47 and the 1947-48 broods are summarized in table 6.

Table 6.--Comparative effectiveness of TDE and DDT in controlling larvae of the Japanese beetle in established turf. Rate of application, 25 pounds per acre

Location of plots	Date of treatment (1947)	Survey made after indicated weeks	Brood	Larval population per square foot in untreated area	Apparent reduction of larvae (percent)	
					TDE	DDT
Blairstown, N.J.	May 20	4	1946-47	14.6	41.7	78.1
		17	1947-48	18.7	83.6	99.8
		55	1947-48	5.5	99.5	100.0
Orange, N.J.	May 26	4	1946-47	7.6	76.2	75.4
		17	1947-48	23.8	88.8	99.4
		54	1947-48	16.0	100.0	100.0
New London, Conn.	May 28	4	1946-47	12.1	30.5	10.2
		17	1947-48	24.2	49.6	54.6
		54	1947-48	25.4	82.3	79.1

TDE was slower than DDT in reducing the 1946-47 brood of larvae at Blairstown, and about equal to DDT against this brood at Orange and New London. It was slower than DDT against the 1947-48 brood at Blairstown and Orange and about equal to DDT at New London. In general TDE seemed to be slightly less effective than DDT.

Summary

In preliminary tests at Lebanon, Pa., in 1946 for the control of the adult Japanese beetle (Popillia japonica Newm.), emulsions of TDE and DDT gave comparable results on hybrid corn when applied by airplane at the rate of 1 pound of toxicant per acre. In 1947 wettable-powder sprays

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of TDE were inferior to those of DDT when applied with a mist blower to corn at Lebanon, but both insecticides gave equally good results when applied to peaches with an orchard sprayer at Shiloh, N. J.

In preliminary laboratory tests with TDE and DDT mixed with soil, TDE appeared to be slightly less toxic than DDT to third-instar larvae. TDE also appeared to be slightly less effective than DDT in controlling infestations of larvae in turf at Blairstown, N. J., and at Orange and New London, Conn., when applied as a dust to the surface.